CLAIMS

1. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN UPSTREAM CHANNEL, applicable to two-way communication over the electricity network, including means to add and extract a cyclic prefix (10) from OFDM symbols (7) in order to avoid intersymbol interferences (ISI), and in which a synchronization in frequency and time is carried out in a downstream channel, determined by the communication from the head-end equipment (1) with the user equipments (2) by means of sending synchronization sequences (3); said Process for Synchronization of Communication comprising:

- frequency synchronization by means of correcting a sampling frequency in the multiple user equipments (2) from an estimation carried out in the frequency synchronization in the downstream channel;

characterized in that said Process for Synchronization of Communication further comprises:

- pre-compensation, in the user equipments (2), of a rotation that various carriers suffer on being sent in the upstream channel from an estimation of the rotation suffered by the carriers in the downstream channel, avoiding corrections in reception in the upstream channel by the head-end equipment (1);
- time synchronization by means of an estimation, carried out by the user equipments (2) and the head-end equipment (1), of a moment when the OFDM symbols (7) are sent to the head-end, in order to make the head-end receive the OFDM symbols in previously fixed moments of time;
- interrogate the user equipments (2) by means of assignation by the head-end of intervals selected from: time intervals, frequency intervals, and combinations thereof in the upstream channel, slots (19), divided in fragments (27) for the interrogation of the user equipments (2) where the user equipments (2) reply to the head-end (1) if and only if user equipments (2) intend to access the upstream channel; from which the head-end equipment (1) distributes the

upstream channel between petitions received and sends said distribution to the user equipments (2) in order to make the user equipments (2) transmit without collisions.

2. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 1, characterized in that said Process for Synchronization of Communication comprises the use of equal oscillators to generate the transmission and reception sampling frequencies both in the head-end equipment and the user equipments, in order to make frequency error in the upstream channel proportional to frequency error in the downstream channel and to carry out synchronization in frequency in the upstream channel at the same time that synchronization in frequency in the downstream channel.

3. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 2, characterized in that the pre-compensation of the rotation carried out in the user equipments is accomplished by means of a rotor included in the transmitter, estimated from the estimation carried out in each one of the carriers of the received signals in the downstream channel in the user equipment, avoiding rotation correction of the signal received from the various user equipments in the head-end equipment.

4. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 1, characterized in that time synchronization comprises generating and sending at least one synchronization sequence from the user equipment (2) to the head-end (1) at request of the head-end equipment; the synchronization sequence comprising two identical synchronization symbols, and said synchronization sequence

being detected in the head-end by maximizing the maximum likelihood criteria, in order to carry out the time synchronization from a calculation of maximum correlation the sequence samples sent by the various users, said maximum being determined as the mid point in a flat zone of a correlation peak whose size in number of samples, is equal to the number of samples of the cyclic prefix (10) without intersymbol interference.

5. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 4, characterized in that time synchronization comprises an acquisition stage and a tracking stage in which the moment of transmission of the OFDM symbols (7) is modified in the different user equipments (2), from an estimation carried out in order to make said symbols be received by the head-end equipment in previously established fixed moments in time.

6. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 5, characterized in that the time synchronization acquisition stage is determined by an open loop in which the user equipments (2) estimate (12) the start (8) of transmission for each OFDM symbol (7) beginning from the time synchronization obtained in the downstream channel; by having estimated the moment of arrival (9) of the OFDM symbols (7) received in the downstream channel, the user equipment compensates the delay introduced by the filters in its receiver and transmitter, as well as the average error which is established due to the cyclic prefix (10) and transmits the OFDM symbols (7) in the moment (9) estimated following the compensation.

7. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claims 5 or 6, characterized in that the time synchronization

tracking stage is determined by a closed loop in which the head-end equipment (14) estimates, by means of the received signal (13) that was sent in the time synchronization acquisition stage by a user equipment (2), the number of samples that the sending of OFDM symbols (7) must be advanced or delayed by said user equipment in order to receive them exactly in the moment expected; therefore the head-end equipment sends (15) said number of samples to the user equipment in the downstream channel as a parameter of the SAM message (26) that the head-end conventionally sends to the user equipment, and from this, the user equipment (16) carries out said advance or delay in sending the OFDM symbols, continually undertaking the open loop of the time synchronization, so that the estimation carried out by the closed loop compensates the delay introduced by the channel.

8. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 4, characterized in that the head-end equipment indicates to the various user equipments when to send synchronization sequences (3), and grants slots by means of SAM messages sent in the downstream channel, so as to carry out adequate synchronization with respect to the user equipment, so that the detection of synchronization sequences (3) for a user in the upstream channel is only carried out that user was ordered to send the synchronization sequence.

9. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 1, characterized in that the head-end equipment assigns interrogation slots (19), divided in fragments (27) by means of sending SAM messages (26) to the various user equipments (2), said user equipment, in the case where they need to transmit, transmitting a POLLING symbol (20) in the assigned fragments (27), in order to make the head-end equipment determine which user equipment intends to transmit information and optimises the distribution algorithms of the upstream channel between the

user equipments.

10. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 9, characterized in that the interrogation slots (19) are divided into small fragments that are equal to or greater than the size of the POLLING symbol (20) in order to interrogate various user equipments at the same time, therefore, the head end, by means of SAM messages, assigns a fragment to at least one user equipments that intend to interrogate and in which the user that intends to transmit replies to the interrogation by means of a POLLING symbol (20) in the assigned fragment.

11. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 10, characterized in that in each fragment the users send only one POLLING symbol (20), leaving the rest of the fragment in silence (21) when said fragment occupies more than one symbol, in order to avoid overlapping of POLLING symbols (20) in reply to the interrogation of the users, when replying in two distinct fragments while the user equipments are not correctly synchronized in time.

12. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 11, characterized in that the detection of the POLLING symbol (20) is carried out by means of the correlation of the received signal and of a POLLING symbol previously stored in the head-end equipment, by means of a matched filter in order to carry out detection.

13. PROCESS FOR SYNCHRONIZATION OF COMMUNICATION INVOLVING MULTIPLE USER EQUIPMENTS WITH A HEAD-END

EQUIPMENT BY MEANS OF OFDM MODULATION IN THE UPSTREAM CHANNEL, according to Claim 12, characterized in that the POLLING symbol (20) has X equal parts to use a finite response matched filter with N/X products (23) and delays (22), where N is the number of samples in the POLLING symbol (20) sent by the user in the fragment assigned by the interrogation slot (19), when requiring to transmit in the upstream channel.